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Pfaff, Jr.

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(54) **ROTARY CUTTING TOOL**

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(52) **U.S. Cl.** **83/698.42**; 83/698.51

(58) **Field of Classification Search** 83/698.41, 83/698.42, 698.51, 698.61, 698.31, 346, 83/347; 29/895.2, 895.21, 895.3; 101/378, 101/382, 415.1

See application file for complete search history.

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(57) **ABSTRACT**

A rotary cutting tool comprises a rotary die cylinder having an axis of rotation, a pair of sides and a cylindrical surface, a die plate positioned around the cylindrical surface of the die cylinder and rigidly attached to the die cylinder at a first location, and an adjustable slide assembly operatively connecting the die plate to the die cylinder at a second location, and slidable with respect to the die cylinder between a retracted position and an extended position. The adjustable slide assembly is slidable along either a first direction around the axis of rotation of the die cylinder or a second direction parallel to the axis of rotation of the die cylinder. Adjustment of the adjustable slide assembly adjusts the position of the die plate with respect to the cylinder. The cylinder may be formed as a single piece assembly or as a first piece and a bar attached to the first piece. The bar can be machined to define in combination with the first piece the cylindrical surface.

21 Claims, 9 Drawing Sheets

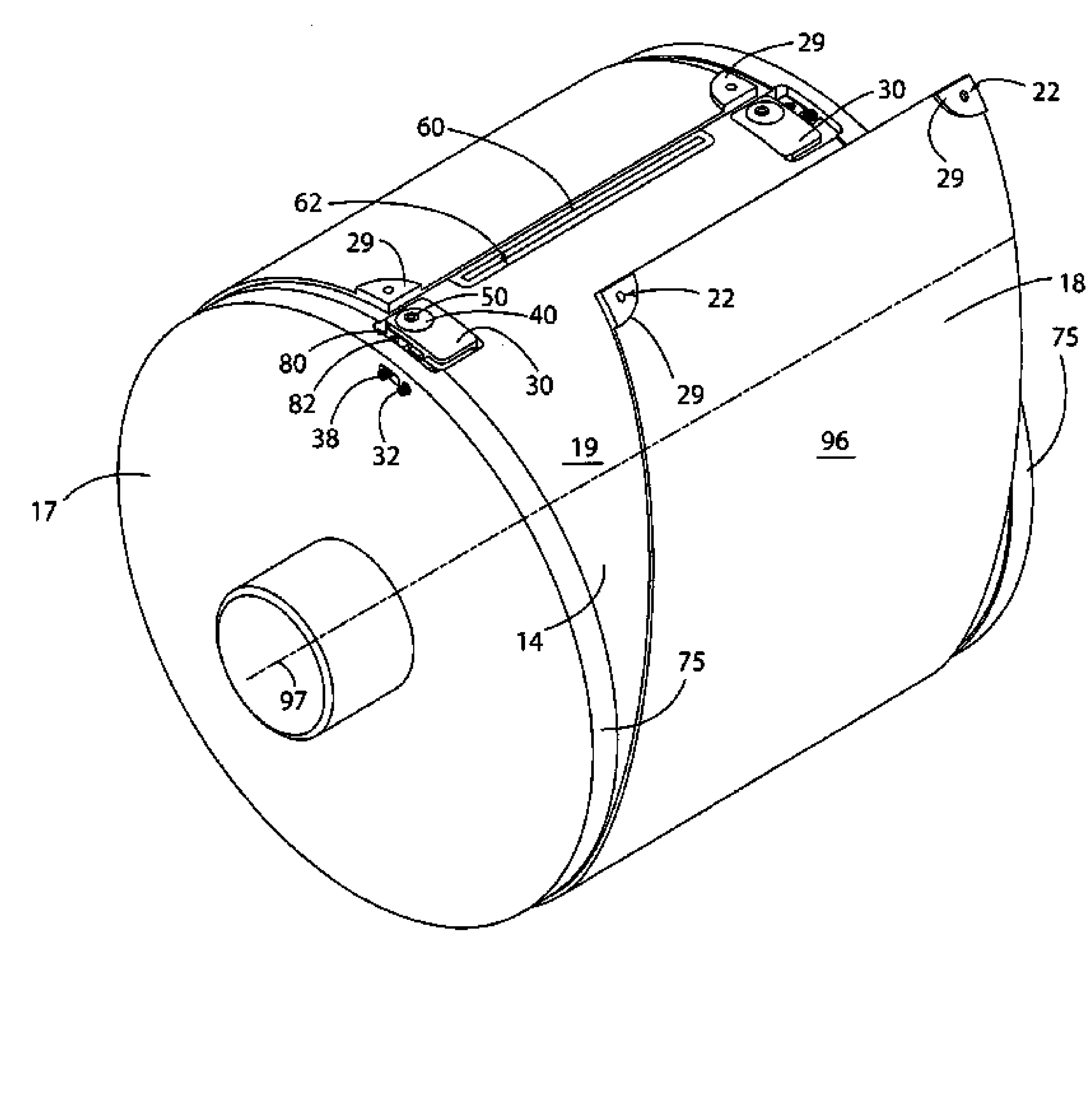

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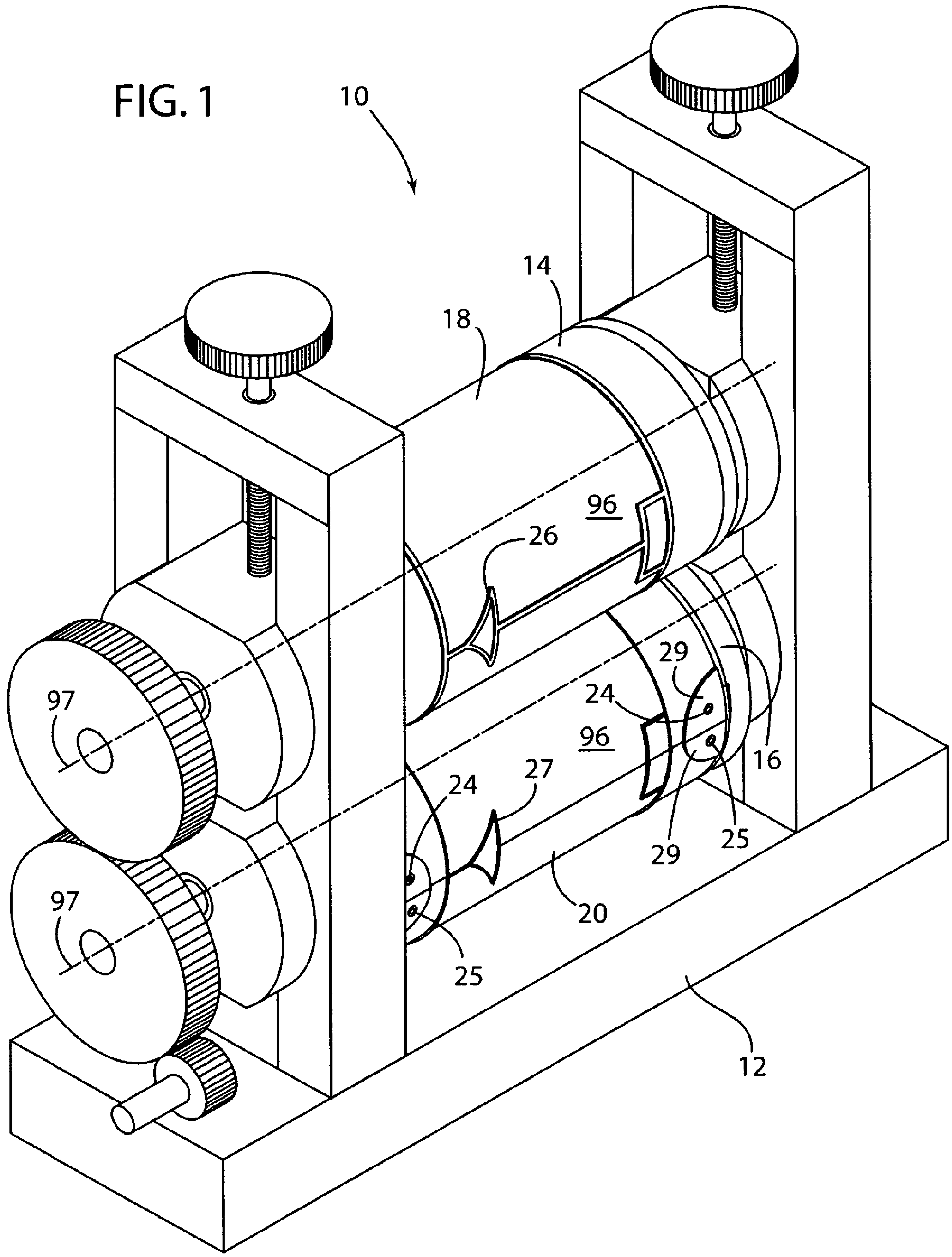
FIG. 1



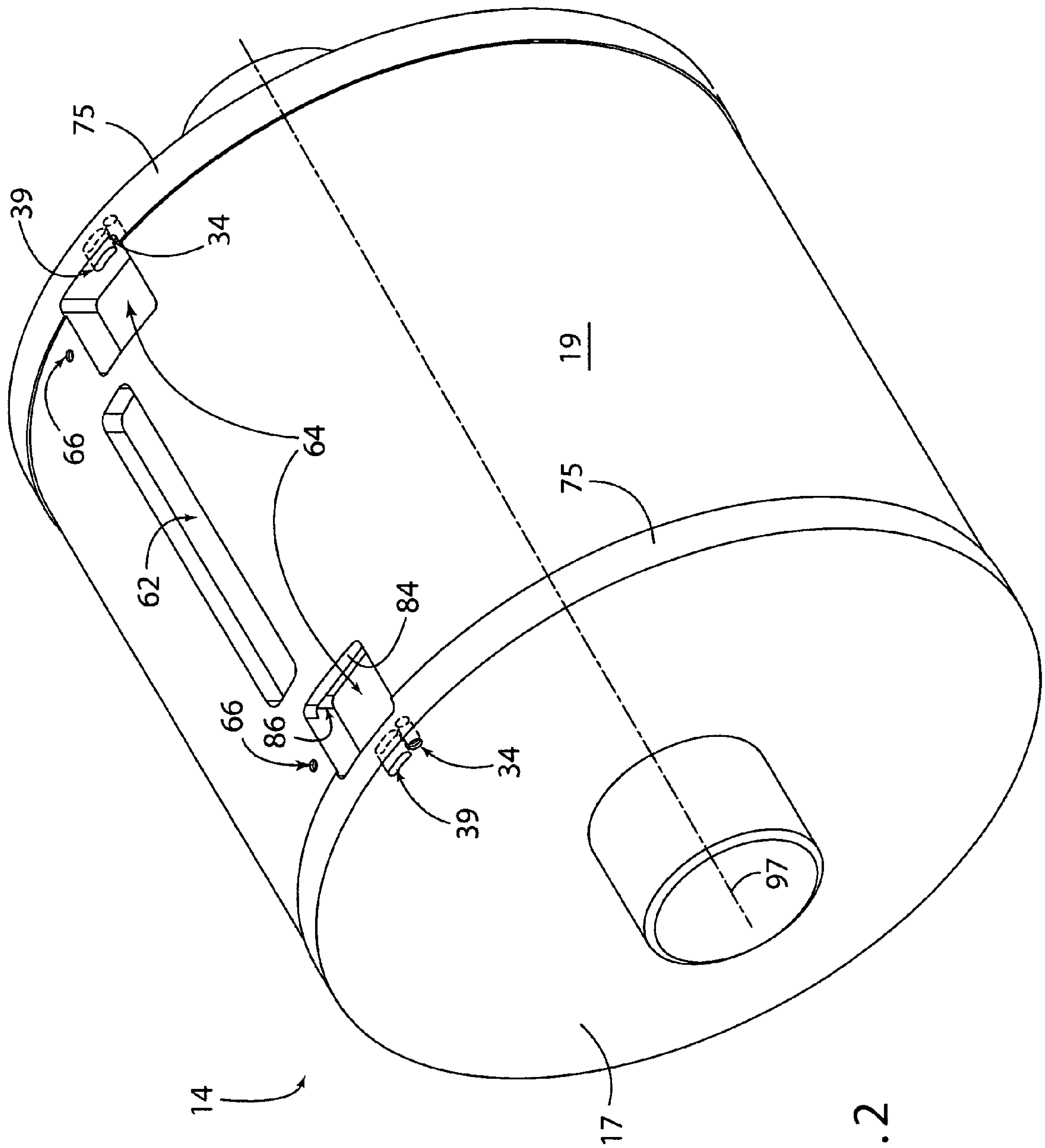


FIG. 2

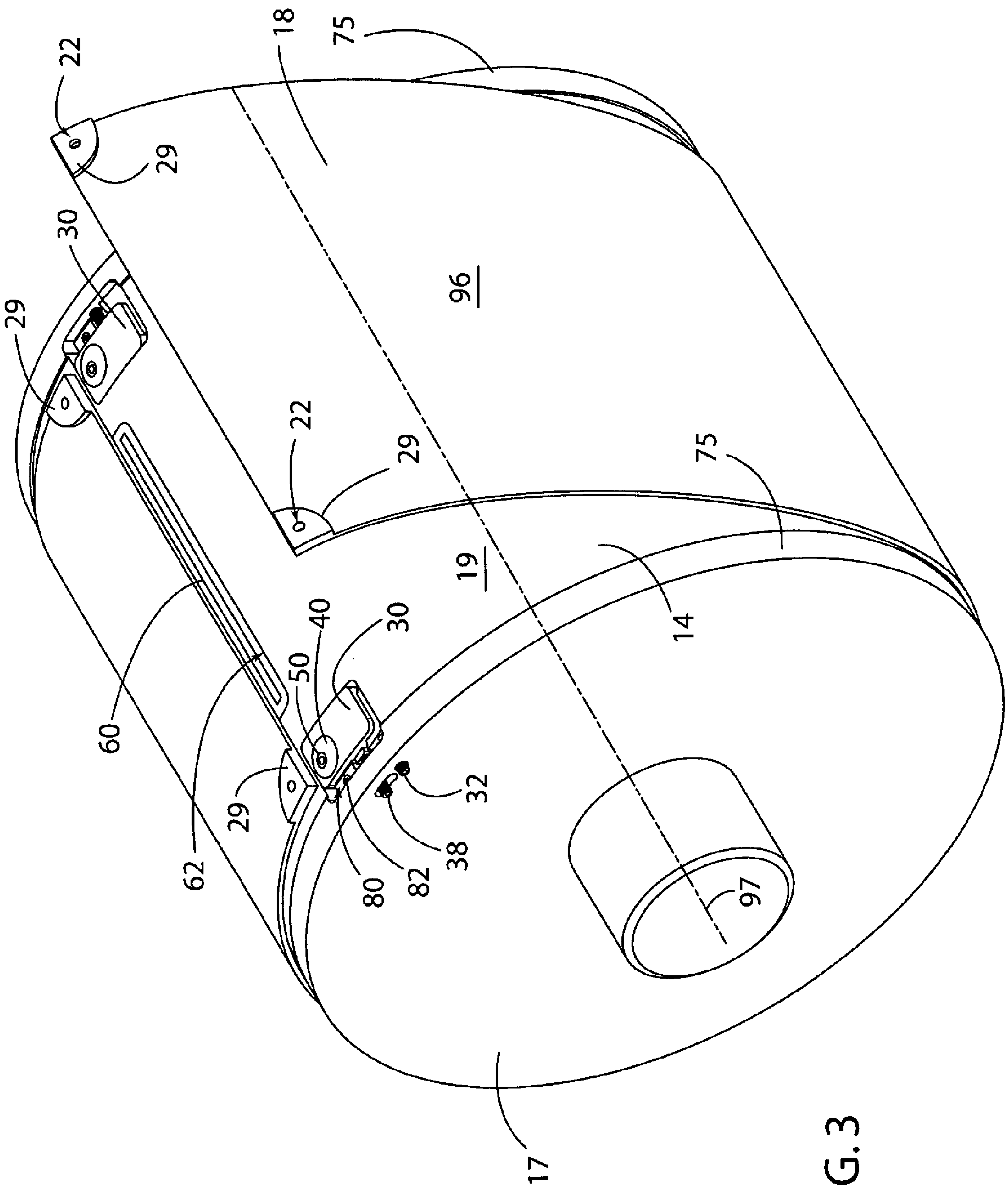
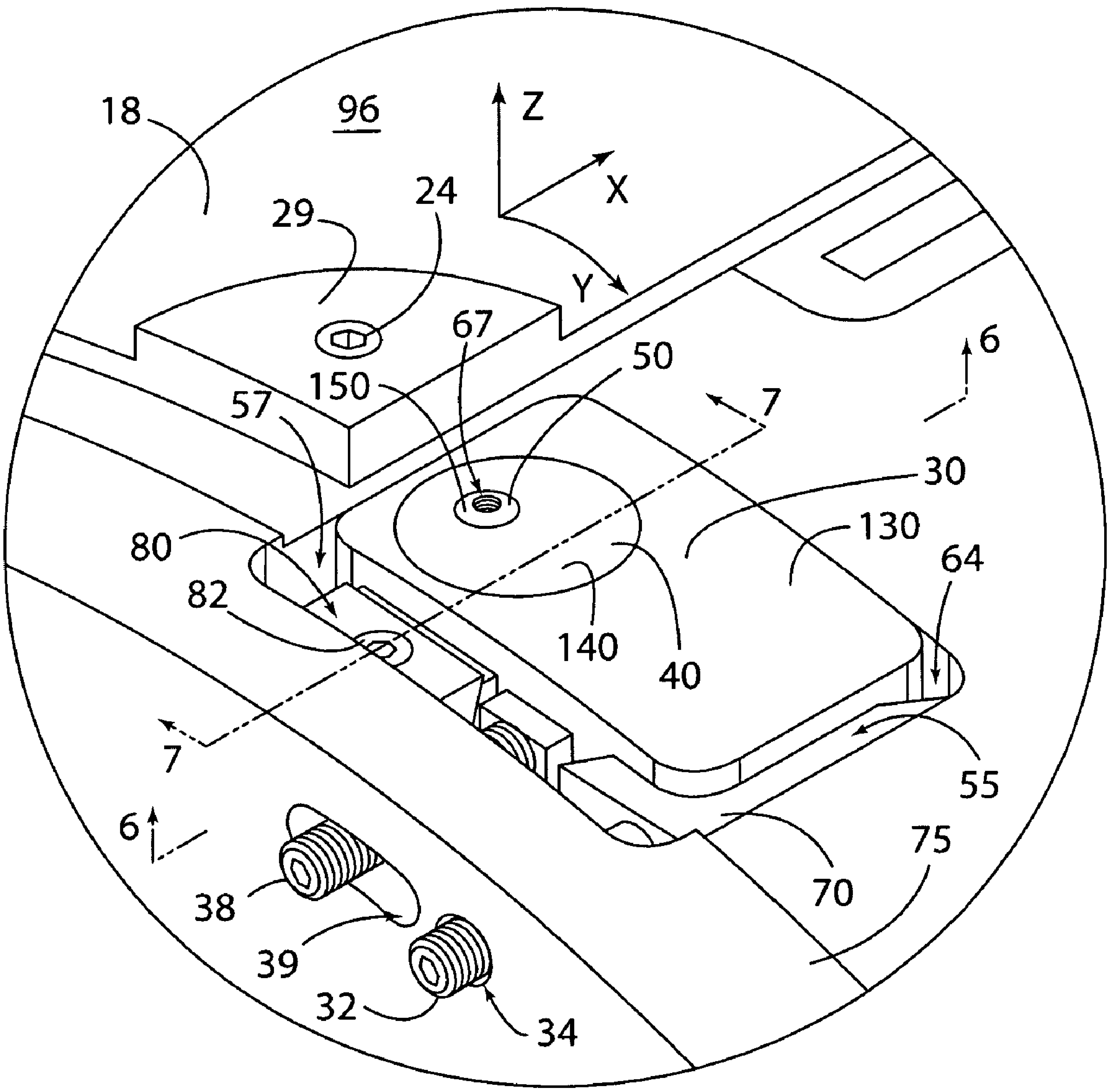


FIG. 3

FIG. 4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96
Z
X
Y
29
24
67
50
6
150
7
57
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55
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75
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38
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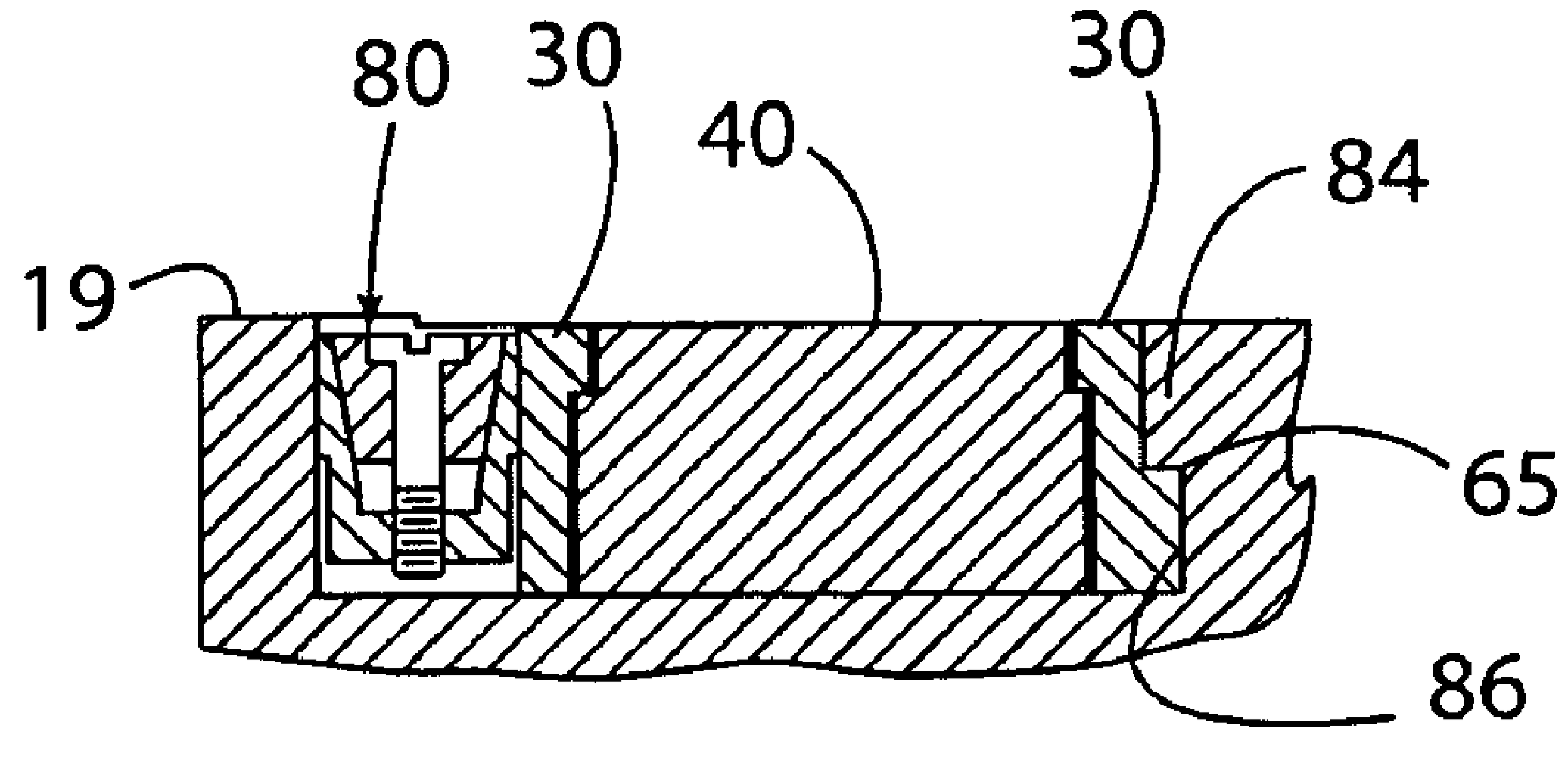
32
34

FIG. 7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65
86

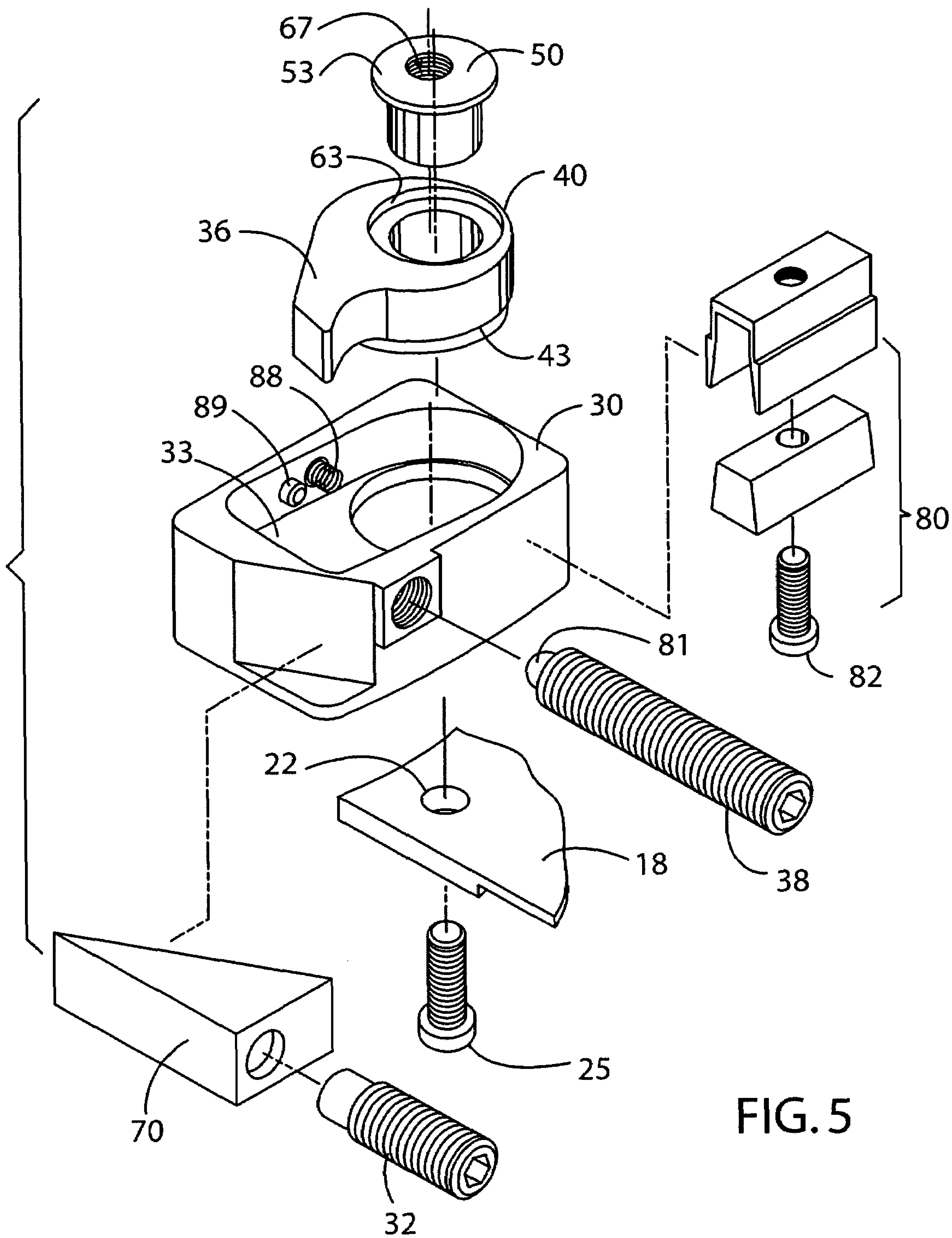


FIG. 5

FIG. 6

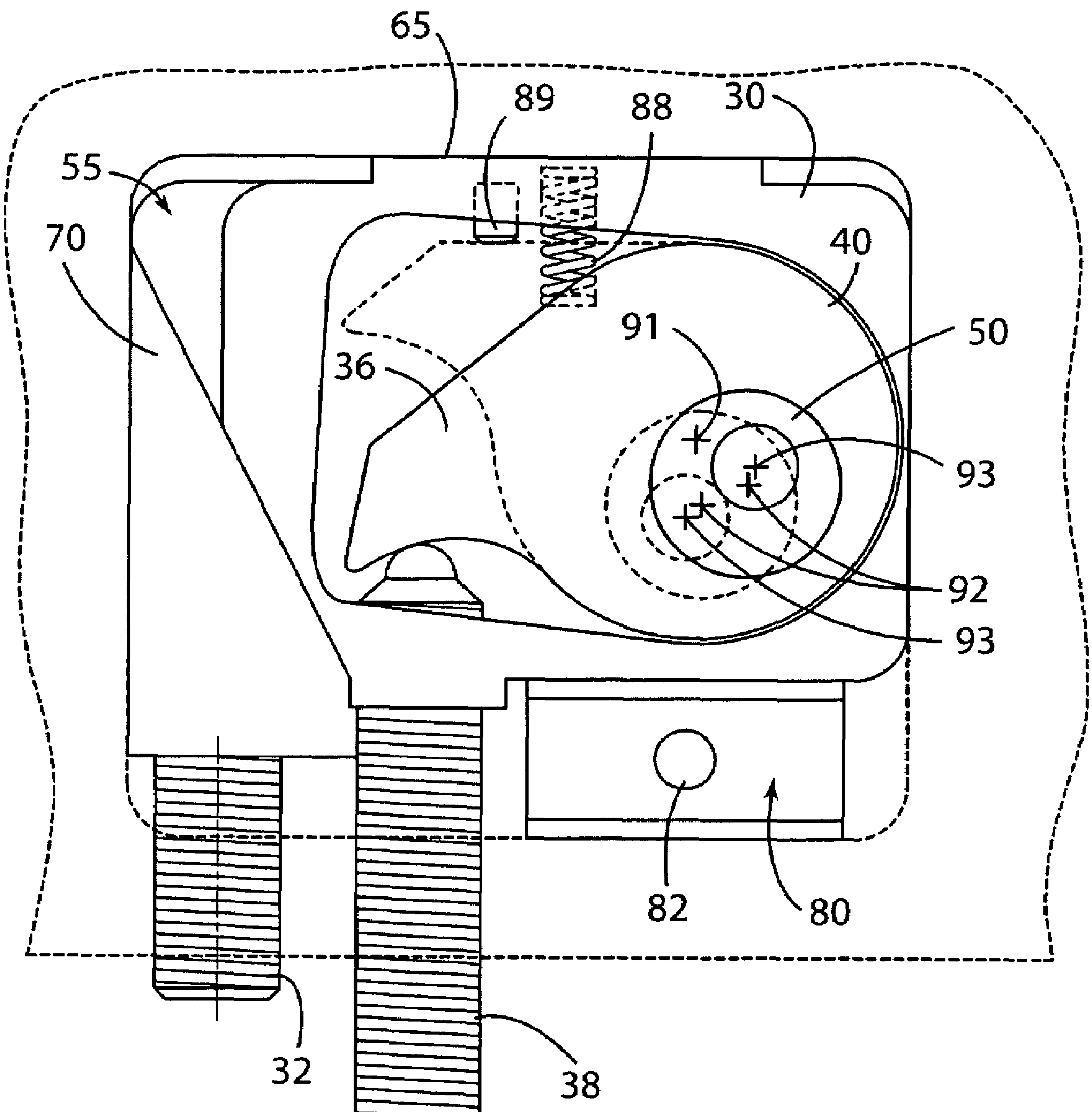
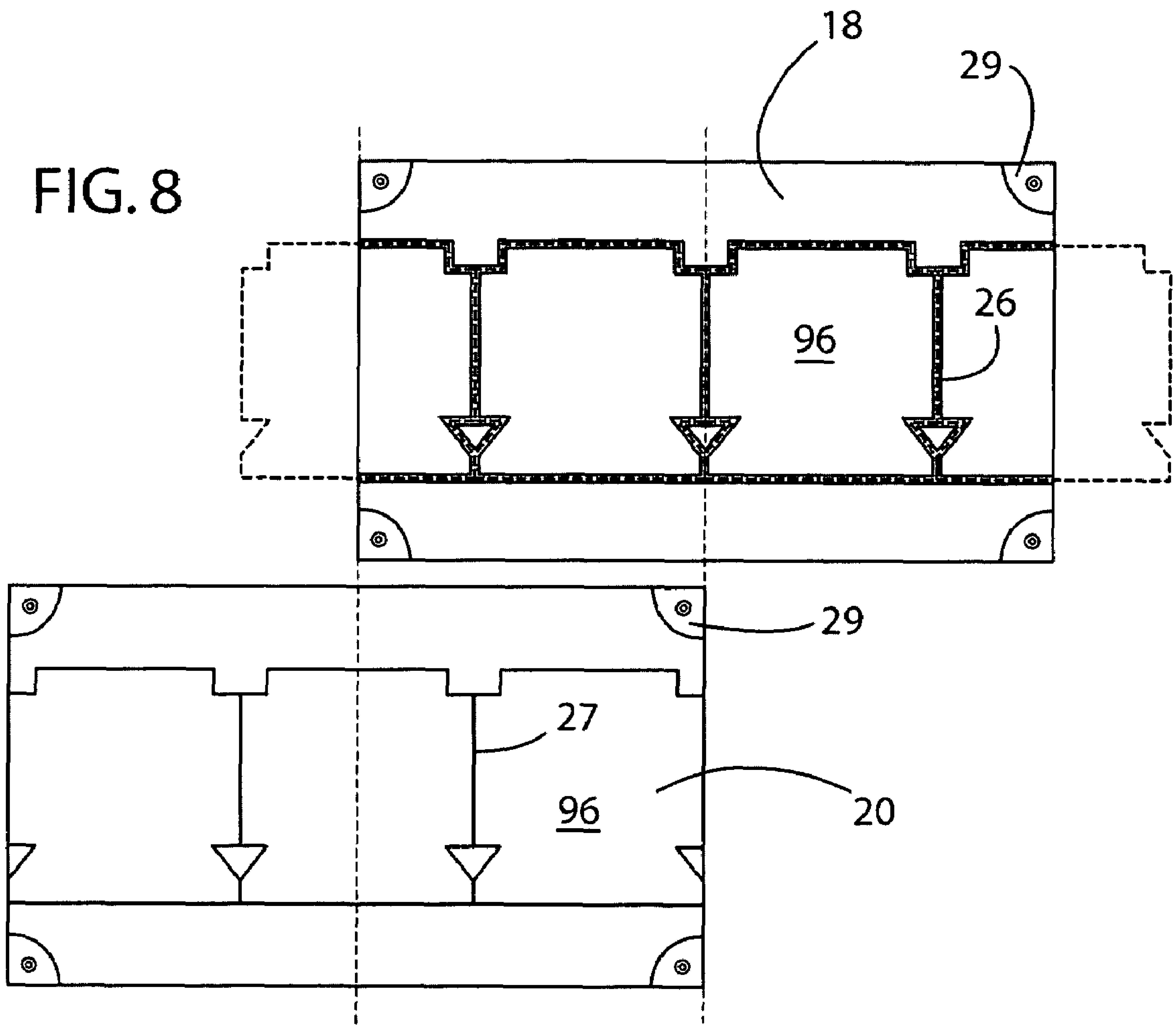


FIG. 8



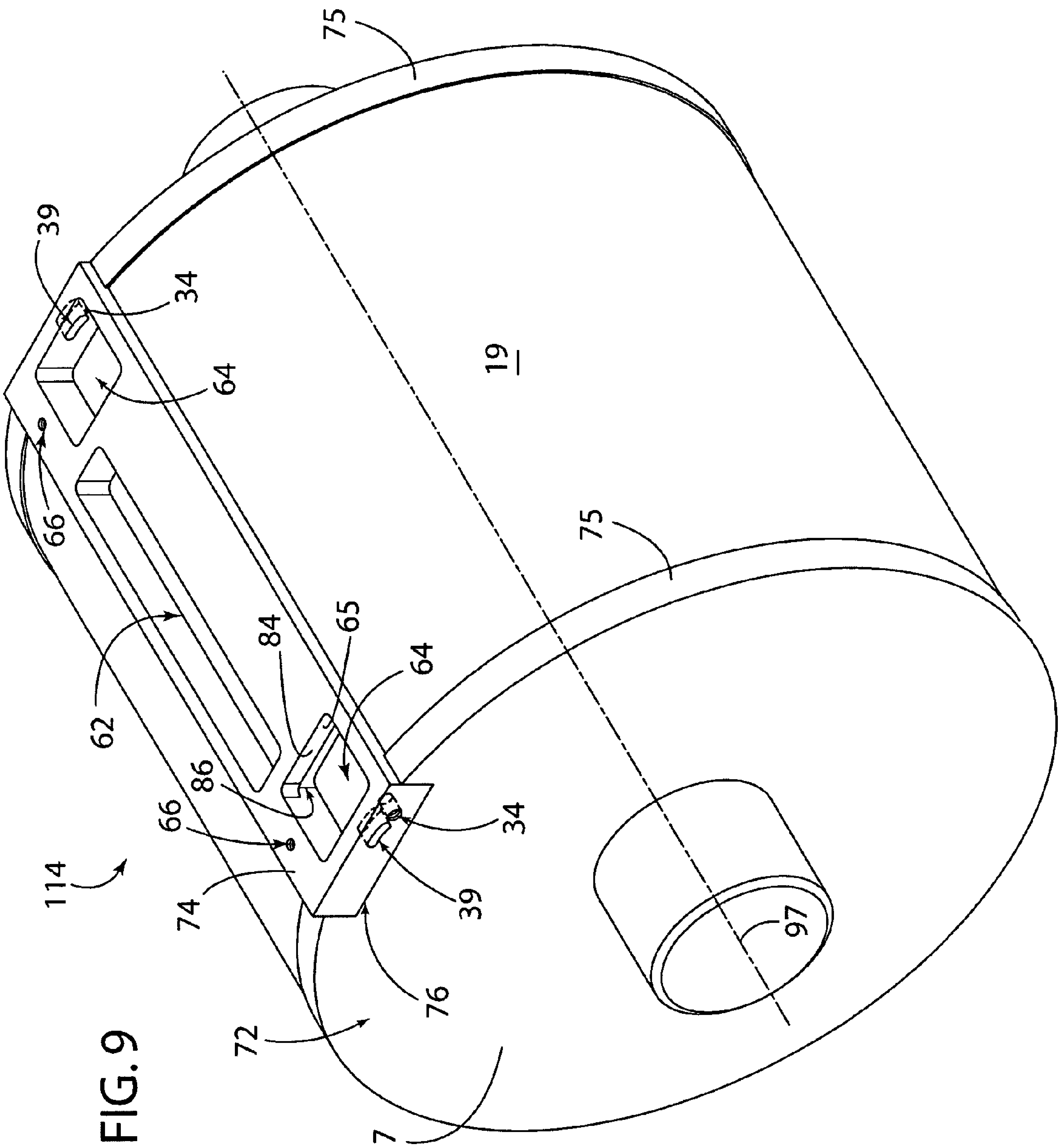


FIG. 9

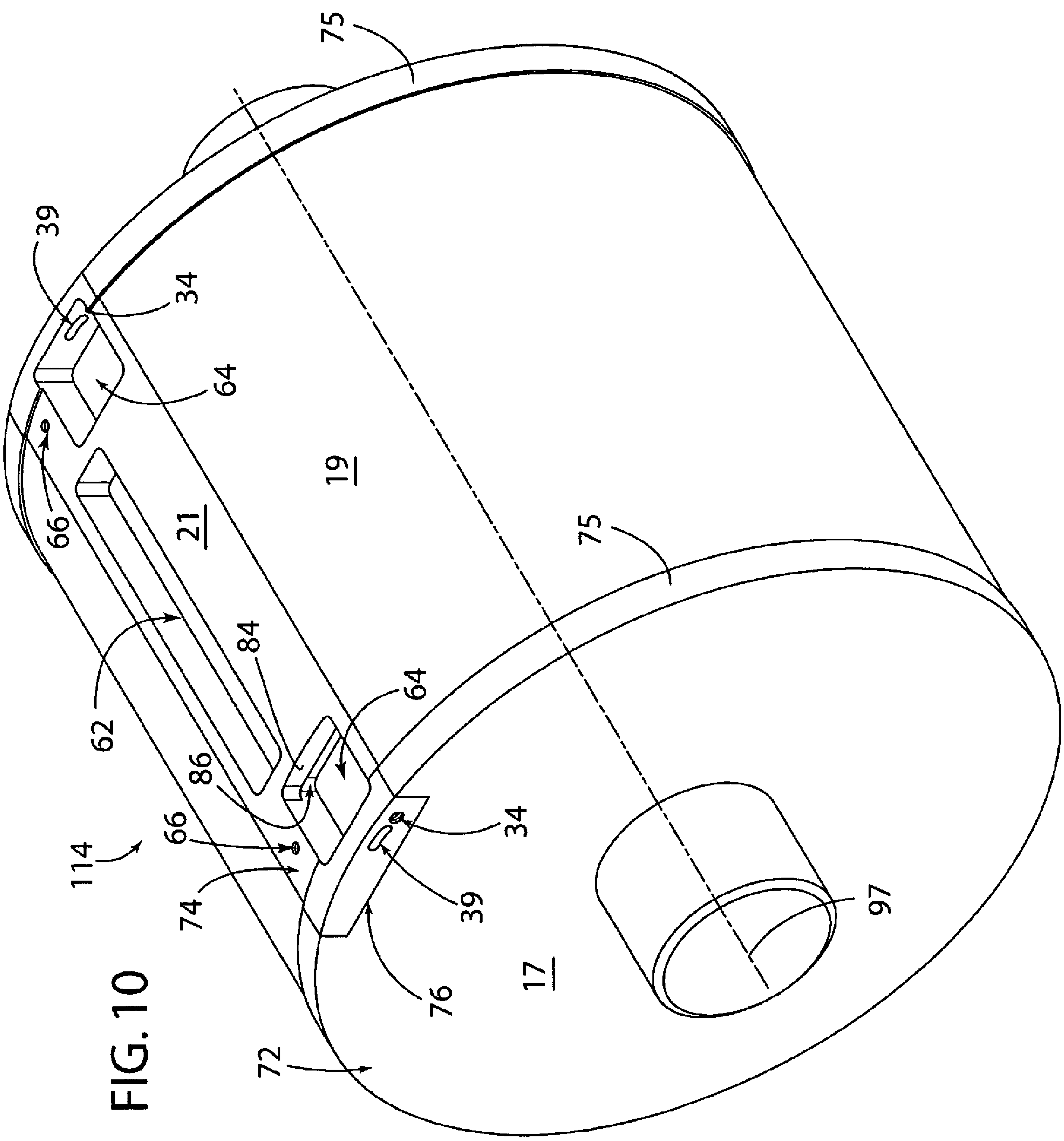


FIG. 10

ROTARY CUTTING TOOL

FIELD OF THE INVENTION

This invention relates to improvements in rotary cutting tools, and more particularly to improvements in control of the position of a die plate on the rotary cutting tool.

BACKGROUND OF THE INVENTION

Rotary cutting tools are useful for cutting thin material such as, for example, paper, paperboard, cardboard, plastic film, metal foil, thin sheet metal, etc. Generally a stream of paperboard or other thin material is fed between a pair of rotating cylinders. The thin material may be received on a large roll and then fed between the rotating dies. The cylinders have cutting surfaces which cut the thin material as it streams between the cylinders, allowing for high volume production of cut blanks. Rotary cutting tools include solid rotary dies, where the cutting surface is made part of the cylinders, and flexible rotary dies, where a die plate is wrapped around a cylinder.

It is important that the die plates of flexible dies be properly affixed to the cylinder and aligned, both with respect to the cylinder and with respect to each other. This is especially important given the speed of rotation of the die cylinders associated with high volume production. Known techniques for affixing and aligning the die plates include forming the die plate and die cylinders out of a magnetic material so that they are magnetically attracted to one another. However, such a design greatly increases the costs of the die cylinders.

U.S. patent application Ser. No. 10/730,580, assigned to the assignee of the present application, discloses a highly advantageous design for a rotary cutting tool where eccentrics are used for position adjustment of the die plate. It would be highly desirable to provide a rotary tool having an improved retaining and adjustment mechanism for use with eccentric position adjustment.

SUMMARY OF THE INVENTION

In accordance with a first aspect, a rotary cutting tool comprises a rotary die cylinder having an axis of rotation, a pair of sides and a cylindrical surface, a die plate positioned around the cylindrical surface of the die cylinder and rigidly attached to the die cylinder at a first location, and an adjustable slide assembly operatively connecting the die plate to the die cylinder at a second location, and slidable with respect to the die cylinder between a retracted position and an extended position. The adjustable slide assembly is slidable along either a first direction around the axis of rotation of the die cylinder or a second direction parallel to the axis of rotation of the die cylinder. Adjustment of the adjustable slide assembly adjusts the position of the die plate with respect to the cylinder. The cylinder may be formed as a single piece assembly or as a first piece and a bar attached to the first piece. The bar can be machined to define in combination with the first piece the cylindrical surface.

From the foregoing disclosure and the following more detailed description of various preferred embodiments it will be apparent to those skilled in the art that the present invention provides a significant advance in the technology of rotary cutting tools. Particularly significant in this regard is the potential the invention affords for providing a high quality, low cost rotary cutting tool. Additional features and advantages of various preferred embodiments will be better understood in view of the detailed description provided below.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a rotary cutting tool in accordance with a preferred embodiment, showing the die plates indexed with respect to one another.

FIG. **2** is an isolated perspective view of one of the die cylinders in accordance with the preferred embodiment of FIG. **1**.

FIG. **3** is a perspective view of one die cylinder, showing the die plate partially unwrapped.

FIG. **4** is an isolated perspective view focusing on one of the adjustable slides.

FIG. **5** is an exploded perspective view of the adjustable slide shown from the underside.

FIG. **6** is a cross section, underside view of the adjustable slide assembly taken through line **6-6** in FIG. **4**, and shows a range of motion of the external eccentric in response to adjustment of the eccentric set screw.

FIG. **7** is a cross section view taken along line **7-7** in FIG. **4**, showing how the adjustable slide is slidably secured to the die cylinder.

FIG. **8** is a schematic showing a pair of die plates treated as flat surfaces, each offset from one another to allow space for the thick die plate corners and to account for the offset in the cut blank shape defined by the cutting surfaces.

FIG. **9** is a perspective view of a die cylinder in accordance with another preferred embodiment where a single slot is machined into the cylinder and the adjustment and attachment elements are mounted on a bar.

FIG. **10** is a view of the die cylinder of FIG. **8** after a top surface of the bar and the die cylinder has been ground to a uniform outside diameter.

It should be understood that the appended drawings are not necessarily to scale, presenting a somewhat simplified representation of various preferred features illustrative of the basic principles of the invention. The specific design features of the rotary cutting tool as disclosed here, including, for example, the specific dimensions of the eccentrics, will be determined in part by the particular intended application and use environment. Certain features of the illustrated embodiments have been enlarged or distorted relative to others to help with clear understanding. In particular, thin features may be thickened, for example, for clarity of illustration. All references to direction and position, unless otherwise indicated, refer to the orientation illustrated in the drawings.

DETAILED DESCRIPTION OF CERTAIN PREFERRED EMBODIMENTS

It will be apparent to those skilled in the art, that is, to those who have knowledge or experience in this area of technology, that many uses and design variations are possible for the rotary cutting tool disclosed here. The following detailed discussion of various alternative and preferred features and embodiments will illustrate the general principles of the invention with reference to a rotary cutting tool suitable for use in industrial applications where flat paper-like materials are to be cut. Other embodiments suitable for other applications will be apparent to those skilled in the art given the benefit of this disclosure.

Referring now to the drawings, in FIG. **1** shows a rotary cutting tool **10** in accordance with a preferred embodiment. Rotary die cylinders **14**, **16** each have an axis of rotation **97** and are mounted on a stand **12** so that the cylinders **14**, **16** come into close proximity with one another. Wrapped around each die cylinder is a corresponding die plate **18**, **20**. Each die plate has cutting blades **26**, **27** rising above and thicker than a base surface **96**. When a thin material is fed between the die plates, the blades rotate with the cylinders, cut the thin material, and the thin material is then removed from the cutting area. In certain preferred embodiments one die plate may have a cutting blade **26** and the other die plate may have a counter element **27** which cooperates with the blade to cut the thin material into cut blanks.

Each die plate is a generally rectangular piece, often a flexible metal. The top die plate **18** wraps around the cylindrical surface **19** (shown in FIG. **2**) of die cylinder **14**, and the bottom die plate **20** wraps around the corresponding cylindrical surface of die cylinder **16**. Each die plate is mounted on its corresponding die cylinder at four locations generally adjacent the four corners **29** of each die plate. Preferably the four corners **29** of the die plate are reinforced by having a larger thickness than the surrounding base surface **96**, as seen in FIG. **1**. Once wrapped around the cylinders, a pair of die plate corners **29** are positioned generally adjacent one another. The die plates **18**, **20** may preferably be offset from one another to allow space for the thicker corners as they rotate. In the preferred embodiment shown in FIG. **1**, the offset is 180 degrees. That is, the corners are located 180 degrees apart from one another so that as they rotate about their respective cylinder the die corners of one die plate **18** do not meet the die corners of the second die plate **20**.

The position of the die plates **18**, **20** with respect to the corresponding die cylinders **14**, **16** is adjustable at one or more of these mounting locations. In the preferred embodiment shown in the drawings the die plates are provided with four openings **22**, one at each corner. Into each of these openings extends a fastener such as a pin **24** or set screw **25** which helps secure the die plate to the die cylinder. Two of the openings **22** receive a pin **24** which is attached to the cylinder at openings **66** (shown in FIG. **2**), providing a fixed mounting and reference location. The other two openings **22** allow a set screw **25** to extend into an adjustable slide assembly, allowing for an adjustable mounting location as discussed in further detail below. Adjustable mounting locations for some of the fasteners are highly desirable in that they help position the die plate on the cylinder without buckling or irregular surfaces, and allow for precise alignment of the die plates with respect to one another. Other combinations of fasteners, fixed mounting locations and adjustable mounting locations will be readily apparent to those skilled in the art given the benefit of this disclosure.

FIG. **2** shows a first preferred embodiment of the die cylinder **14**, having a cylindrical surface **19** with a constant radius about an axis of rotation **97**. Two sides **17** extend from either end of the cylindrical surface **19** (only one side is visible in the perspective view of FIG. **2**) generally perpendicular to the axis of rotation and to the cylindrical surface. A pair of pockets **64** are provided in the cylindrical surface of the cylinder **14**, and have undercuts **86** beneath overhangs **84** so as to be sized to receive adjustable slide assemblies as discussed in greater detail below. A first opening **39** and a second opening **34** are positioned on each side **17**, and connect to the corresponding pocket **64**. In certain preferred embodiments the openings **39** and **34** may be formed as a single opening. Openings **66** on the cylindrical surface **19** of the die cylinder **14** are sized to receive pins for securing a die plate to the cylinder. Optional elongate recess **62** is shown, running generally parallel to the axis of rotation **97**. A magnet **60** may be placed in the elongate recess **62** (seen in FIG. **3**). The magnet may be used to temporarily hold the die plate **18** until the final die plate position is set by movement of the adjustable slide assembly. Bearer surfaces **75** may be provided, extending radially around the axis of rotation a little beyond the cylindrical surface. The bearer surfaces can engage bearer surfaces on an adjacent cylinder and thereby act as protection for the cutting surfaces of the die plates.

FIG. **3** shows a die plate **18** with the cutting surfaces removed, leaving only the die corners **29** and the base surface **96**. The die plate is partially unwrapped around a die cylinder **14**, revealing a pair of adjustable slide assemblies, each residing in a pocket **64**. Each adjustable slide assembly preferably comprises an adjustable slide **30**, first eccentric **40**, second eccentric **50**, and various other elements as described in greater detail below. The adjustable slides are attached to the die plates remote from the cutting surfaces of the die plates. More specifically, as shown in the Figs., the adjustable slides are positioned on the underside of the die plate, the side opposite the side of the die plate with the cutting surfaces. In the embodiment shown in the drawings, pair of fixed pins secure the die plate and a pair of set screws is attached to a pair of adjustable slide assemblies slidable along the Y-axis. Alternatively, one of the fixed pins may be replaced with an adjustable slide assembly slidable along the X-axis, if needed.

FIG. **4** is a close-up view of one of the adjustable slide assemblies. Preferably the die plates are adjustably captivated to the die cylinder in the pocket. Adjustably captivated, as used herein means that the motion of one part with respect to another part is partially restricted. For example, the adjustable slide **30** is free to slide back and forth with respect to the die cylinder around the axis of rotation of the die cylinder (along the Y-axis labeled in FIG. **4**). However, the adjustable slide is captivated so that it is held in the pocket, and cannot leave the pocket along the Z-axis. In a similar manner the outer eccentric **40** is adjustably captivated to the slide **30**, and the inner eccentric **50** is adjustably captivated to the outer eccentric **40**.

The pocket **64** is preferably oversized, in the sense that the adjustable slide **30** in inserted into the pocket and leaves a gap **55** for adjustment along the Y-axis, and a gap **57** along the X-axis. The surfaces **130**, **140**, **150** of the slide, first eccentric and second eccentric, respectively, are preferably flush with the cylindrical surface **19**. That is, these surfaces may be machined down to share a common radius with the cylindrical surface **19** of the die cylinder **14**. An eccentric adjustment screw **38** extends through first opening **39** on the side wall to urge the outer eccentric **40** to rotate with respect to the adjustable slide. A wedge adjustment screw **32** extends through second opening **34** and engages a wedge **70** to urge the adjustable slide along the Y-axis. First opening **39** and second opening **34** may alternatively be formed as a single opening.

A clamp **80** (adjustable by screw **82**) fills up gap **57**, urging the slide **30** against one wall of the pocket **64**. FIG. **7** shows the adjustable slide **30** captivated in the pocket after adjustment. Slide **30** has a catch **65** which projects into an undercut **86** of the pocket. Overhang **84** prevents dislocation of the slide along the Y-axis. However, when the clamp is unclamped, the slide may be slidable along the Y-axis between an extended position and a retracted position, while still being captivated by the overhang **84**.

FIG. **5** is an exploded perspective view of the adjustable slide assembly, taken from the underside as viewed in FIG. **4**. FIG. **6** also shows the adjustable slide assembly taken from the underside, but along line **6-6** in FIG. **4**. Wedge **70** and clamp **80** cooperate to secure the position of the adjustable slide **30**. The outer eccentric sits in a cavity in the adjustable slide. Eccentric engagement screw **38** has a round end **81** which engages wing **36** on the outer eccentric **40**. The outer eccentric is also provided with a shoulder **43** which engages top wall **33** of the adjustable slide. Similarly, a shoulder **53** on the smaller eccentric **50** engages a counterbore **63** in the larger eccentric **40**. Opening **67** in the small eccentric **50** receives screw **25**, as well as opening **22** in the die plate. The die plate **18** is captivated between the screw **25** and the slide **30** so that the die plate is adjusted by adjustment of the adjustable slide assembly. Optionally a return spring **88** and/or a hard stop **89** may be provided, mounted on the slide. The stop is a hard stop for the large eccentric, and the return spring provides a biasing force against the outer eccentric to help the eccentric move.

FIG. **6**, with the eccentrics viewed from the underside, shows a range of motion for the eccentrics after the adjustable slide has been clamped into a fixed position. The large eccentric rotates about a first axis **91** over a travel range of about 60-70 degrees from a fully released position in the preferred embodiment shown in the drawings. The inner eccentric **50** rotates about a second axis **92**, defined by the opening in the large eccentric to be offset from the first axis. Thus, rotation of the large eccentric **40** moves the second axis **92** with respect to the first axis **91** about an arcuate vector. The fastener **25** (which is attached to the die plate) is positioned in an opening in the inner eccentric **50** so as to be movable about a third axis **93**, offset from both the first axis **91** and the second axis **92**. The third axis **93** is rotatable with respect to the second axis about another arcuate vector. Since the die plate travels with the third axis, this combination of eccentrics advantageously allows for fine position adjustment of the die plate. That is, the range of adjustment of the die plate due to adjustment of the eccentrics is the resultant of two arcuate vectors. Use of the eccentrics to create such elegant position adjustment advantageously eliminates the need for incorporating magnetic materials into the die cylinder, the die plate or both. Further, use of such eccentrics provides a range of positions to accommodate positional error in the adjustable slide which receives the eccentrics and positional error in the die plate locating holes **22**.

Attachment of the die plate to the die cylinder can be accomplished in the following manner. First, the die plate **18** is attached to the cylinder **14** with the one or more fixed mounting pins **24** at openings **66**. As noted above, the inner eccentric is adjustably captivated by the outer eccentric, and the outer eccentric is adjustably captivated by the adjustable slide, and the adjustable slide is adjustably captivated by the overhang **84** cooperating with the catch **65**. The adjustable slide **30** is inserted into the pocket **64** and retracted to its fully retracted position. The clamp **80** is loose. The outer eccentric **40** is rotated to the fully released position, shown with solid lines in FIG. **6**. Fastener **25** is then attached to the inner eccentric, sandwiching the die plate between the fastener and the adjustable slide **30**. The die plate **18** is now attached to the adjustable slide **30**, but the slide is adjustable along the Y-axis and the X-axis. Rotation of the wedge set screw **32** moves the wedge **70** against the adjustable slide, urging the adjustable slide to a forward position. The forward position is limited by the amount of gap **55** between the adjustable slide and the die cylinder **14**. Movement of the adjustable slide **30** to a forward position acts to tighten the die plate around the cylinder. This step is repeated at each adjustable slide used.

Next, the set screw **38** engaging the outer eccentric wing **36** is rotated, urging the outer eccentric to rotate away from the released position. The eccentrics **40**, **50** cooperate not only to provide a range of adjustment of the die plate, but also maintain tension in the die plate once set to a desired position. Once the desired position of the eccentrics is achieved, accounting for all the various tolerances and minor misalignments, the clamp **80** engaged, typically with an alien wrench turning screw **82**, taking up the gap **57** in the pocket **64**, and locking down the slide **30** so it can no longer move with respect to the die cylinder.

When wrapped around the die cylinders, the die plate corners **29** are positioned generally along a line parallel to the axis of rotation of the respective cylinder, as shown in FIG. **1**. FIG. **8** shows die plates **18** and **20** unwrapped from their respective die cylinders, but still held in position with respect to one another. In accordance with a highly advantageous feature, the corners **29** of the die plates are offset from one another so that the thicker corners do not meet as the cylinders rotate. That is, the first die plate meets the thin material to be cut at a first location or surface, the second die plate meets the thin material at a second location or surface, directly opposite the first location and these surfaces of the die plate cooperate to cut the thin material. When the four corners of the first die plate are at the first location, the four corners of the second die plate are offset from the second location. In the preferred embodiment shown in the Figs., the die plates are offset by 180 degrees, and the pattern of cutting surfaces **26**, **27** for the cut blanks are offset from one another to compensate for the offset positioning on the die cylinders. Each die corner and fastener is positioned opposite a relieved area on the opposing die plate. Also, because the die plate patterns of cutting surfaces for the cut blanks are identical, it is possible to use the offset to place a parting line of each die plate pattern opposite an area where no parting line exists to produce a cleaner and relatively uninterrupted cut and crease effect on the part produced.

FIGS. **9-10** show another preferred embodiment, where the cylinder **114** is formed as a two piece construction, a first piece **72** and a bar **74** having a top surface **21**. The first piece **72** of the cylinder has a slot **76** machined into it, preferably with square sides and a square bottom. The cylindrical surface **19** typically does not extend to the top surface **21**. In accordance with a highly advantageous feature of the invention, all of the adjustment and attachment elements for the die plates may be machined and attached to the bar **74**. Further, the bar **74** can be sized to accommodate a wide variety of die cylinder sizes, and then the top surface **21** may be ground down with the first piece **72** of the cylinder **114** so that the top surface shares the same radius (about axis **97**) as cylindrical surface **19**. Thus, there is provided a constant diameter across both the first piece **72** and the bar **74**, as shown in FIG. **10**.

From the foregoing disclosure and detailed description of certain preferred embodiments, it will be apparent that various modifications, additions and other alternative embodiments are possible without departing from the true scope and spirit of the invention. The embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to use the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

What is claimed is:

1. A rotary cutting tool comprising, in combination:

a rotary die cylinder having an axis of rotation, a pair of sides and a cylindrical surface;

a die plate positioned around the cylindrical surface of the die cylinder and rigidly attached to the die cylinder at a first location; and

at least one adjustable slide assembly operatively connecting the die plate to the die cylinder at a second location, and slidable with respect to the die cylinder between a retracted position and an extended position;

wherein the adjustable slide assembly is slidable along both a first direction around the axis of rotation of the die cylinder and a second direction parallel to the axis of rotation of the die cylinder, while being securely attached to the die cylinder;

wherein adjustment of the at least one adjustable slide assembly adjusts the position of the die plate with respect to the cylinder.

2. The rotary cutting tool of claim **1** wherein the at least one adjustable slide assembly comprises an adjustable slide adjustably captivated to the die cylinder.

3. The rotary cutting tool of claim **2** wherein the adjustable slide is positioned in a pocket in the die cylinder and has a catch, and the die cylinder has an overhang defining an undercut in the pocket which slidably receives the catch.

4. The rotary cutting tool of claim **3** further comprising a clamp moveable between a clamped position and an unclamped position, and located in the pocket adjacent the adjustable slide, wherein the clamp in the clamped position cooperates with the overhang to resist movement of the adjustable slide.

5. The rotary cutting tool of claim **2** wherein the adjustable slide assembly further comprises a first eccentric adjustably captivated by the adjustable slide, and rotatable with respect to the adjustable slide about a first axis.

6. The rotary cutting tool of claim **5** wherein the adjustable slide has a top and the first eccentric has a shoulder which resists movement of the first eccentric in a direction away from the axis of rotation of the die cylinder.

7. The rotary cutting tool of claim **5** further comprising a second eccentric rotatable with respect to the adjustable slide about a second axis offset from the first axis.

8. The rotary cutting tool of claim **7** further comprising a fastener mounted on the second eccentric along a third axis offset from the first axis and the second axis, wherein the adjustable die plate is adjustably captivated between the adjustable slide and the fastener.

9. The rotary cutting tool of claim **7** wherein the second eccentric has a shoulder which engages the first eccentric to resist movement of the second eccentric in a direction away from the axis of rotation of the die cylinder.

10. The rotary cutting tool of claim **2** further comprising a first eccentric rotatable with respect to the adjustable slide, wherein the adjustable die plate is operatively connected to the first eccentric so that rotation of the first eccentric adjusts the position of the die plate; and

a screw engaging the first eccentric, wherein rotation of the screw urges rotation of the first eccentric.

11. The rotary cutting tool of claim **10** wherein the screw engages a wing on the first eccentric.

12. The rotary cutting tool of claim **10** wherein the adjustable slide is positioned in a pocket in the die cylinder, and further comprising a first opening in the side of the die cylinder connected to the pocket, wherein the screw is positioned in the first opening.

13. The rotary cutting tool of claim **2** further comprising a wedge which abuts against the adjustable slide, wherein movement of the wedge urges the adjustable slide assembly to move between the retracted position and the extended position.

14. The rotary cutting tool of claim **13** wherein the adjustable slide is positioned in a pocket in the die cylinder, and further comprising a wedge adjustment screw extending through a second opening in the side of the die cylinder connected to the pocket.

15. The rotary cutting tool of claim **1** further comprising a second die cylinder and a second die plate wrapped around the second die cylinder, wherein both die cylinders are mounted on a stand, and the second die plate cooperates with the first die plate to cut a thin material inserted between the die plates.

16. The rotary cutting tool of claim **15** wherein the first die plate and the second die plate each have four corners, the first die plate meets the thin material at a first location, the second die plate meets the thin material at a second location, and when the four corners of the first die plate are at the first location, the four corners of the second die plate are offset from the second location.

17. The rotary cutting tool of claim **1** wherein the die cylinder has an elongate recess positioned on the cylindrical surface of the cylinder and parallel to the axis of rotation, wherein the elongate recess is adapted to receive a magnet.

18. The rotary cutting tool of claim **17** further comprising a magnet received in the elongate recess in the die cylinder, wherein corners of the die plate are positioned generally along a line parallel to the axis of rotation, and the magnet is positioned underneath the die plate generally adjacent the line defined by the corners of the die plate.

19. The rotary cutting tool of claim **1** wherein the die cylinder comprises a first piece having a slot, and a bar attached at the slot, and the first piece and the bar have an external cylindrical surface of the same radius.

20. The rotary cutting tool of claim **1** wherein the die cylinder has openings adapted to receive fasteners, and fasteners secured to the openings fixedly secure the die plate to the die cylinder at at least one location.

21. A rotary cutting tool comprising, in combination:

a rotary die cylinder having an axis of rotation, a pair of sides and a cylindrical surface;

a die plate having cutting surfaces, positioned around the cylindrical surface of the die cylinder and rigidly attached to the die cylinder at a first location; and

at least one adjustable slide assembly slidable with respect to the die cylinder between a retracted position and an extended position, wherein the at least one adjustable slide assembly continuously engages the die plate;

wherein the adjustable slide assembly is slidable along both a first direction around the axis of rotation of the die cylinder and a second direction parallel to the axis of rotation of the die cylinder, while being securely attached to the die cylinder;

wherein the adjustable slide assembly is attached to the die plate remote from the cutting surfaces, the adjustable slide assembly is attached to the rotary die cylinder, and adjustment of the adjustable slide assembly adjusts the position of the die plate with respect to the cylinder.

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